

(12) **United States Patent**
Sander et al.

(10) **Patent No.:** **US 7,868,582 B2**
(45) **Date of Patent:** ***Jan. 11, 2011**

(54) **PORTABLE DEVICES HAVING MULTIPLE POWER INTERFACES**

2005/0253560 A1 11/2005 Popescu-Stanesti et al.
2006/0273757 A1* 12/2006 Naguib 320/107
2007/0069684 A1 3/2007 Ramsden

(75) Inventors: **Wendell B. Sander**, Los Gatos, CA (US); **Daniel A. Warren**, San Jose, CA (US)

FOREIGN PATENT DOCUMENTS

TW 200742912 11/2007

(73) Assignee: **Apple Inc.**, Cupertino, CA (US)

OTHER PUBLICATIONS

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

Yan Hong Lim, et al., "Simple Maximum Power Point Tracker for Photovoltaic Arrays", Electronics Letters, May 25, 2000, vol. 36, No. 11, 2 pp.
Efthios Koutroulis, et al. "Development of a Microcontroller-Based, Photovoltaic Maximum Power Point Tracking Control System", IEEE Transaction on Power Electronics, vol. 16, No. 1, Jan. 2001, pp. 46-54.
D.P. Hohm, et al., "Comparative Study of Maximum Power Point Tracking Algorithms", Progress In Photovoltaics: Research and Applications, Nov. 22, 2002, pp. 47-62.
Joe-Air Jiang, et al., "Maximum Power Tracking for Photovoltaic Power Systems", Tamkang Journal of Science and Engineering, 2005, vol. 8, No. 2, pp. 147-153.

* cited by examiner

(21) Appl. No.: **12/391,668**

(22) Filed: **Feb. 24, 2009**

(65) **Prior Publication Data**

US 2009/0179611 A1 Jul. 16, 2009

Related U.S. Application Data

(63) Continuation of application No. 11/544,108, filed on Oct. 6, 2006, now Pat. No. 7,514,900.

(51) **Int. Cl.**
H01M 10/44 (2006.01)
H01M 10/46 (2006.01)

(52) **U.S. Cl.** **320/101**

(58) **Field of Classification Search** 320/101, 320/103, 112, 114, 115, DIG. 12; 136/293
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,420,496 A 5/1995 Ishikawa
7,442,077 B2* 10/2008 Peress et al. 439/505

Primary Examiner—Edward Tso

(74) *Attorney, Agent, or Firm*—Kramer Levin Naftalis & Frankel LLP

(57) **ABSTRACT**

Portable devices having multiple power interfaces are described herein. According to one embodiment of the invention, a portable electronic device includes, but is not limited to, a processor, a memory coupled to the processor for storing instructions, when executed from the memory, cause the processor to perform one or more functions, a battery coupled to provide power to the processor and the memory, and a battery charging manager coupled to charge the battery using power derived from a plurality of power sources including a solar power source. Other methods and apparatuses are also described.

21 Claims, 15 Drawing Sheets

